PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Sequestration

03/2004

AN INTEGRATED MODELING FRAMEWORK FOR CARBON MANAGEMENT TECHNOLOGIES

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Background

The Carbon Sequestration Program of DOE's National Energy Technology Laboratory (NETL) has the goal of developing safe, lower-cost methods of carbon capture and sequestration as a potential future option for greenhouse gas mitigation. One element of this program involves the development of modeling and assessments tools to evaluate and compare the overall effectiveness, costs, and sequestration potential of alternative carbon management methods. Tools also are needed to help identify and prioritize the most promising R&D efforts. The project described here was among the first group of projects selected by DOE/NETL in July 2000 under the Carbon Sequestration Program initiative.

Primary Project Goal

The primary goal of this project is to support modeling and assessment activities by developing a systematic framework for characterizing the performance and cost of alternative carbon capture and sequestration technologies applicable to a broad range of electric power systems.

Objectives

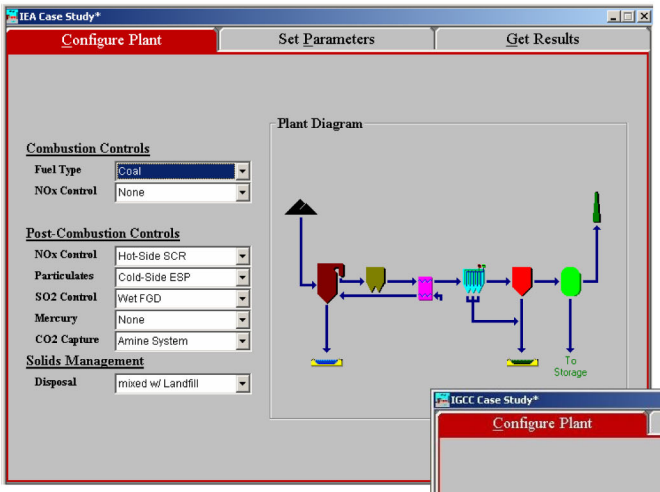
The product of this work is an easy-to-use, state-of-the-art computer model that allows different technology options for CO_2 capture and storage to be evaluated systematically at the level of an individual plant or facility. The model takes into account not only the avoided carbon emissions, but also the multi-pollutant impacts on criteria air pollutants, air toxics and solid wastes. Uncertainties and technological risks also can be explicitly characterized. The modeling framework includes combustion-based power plants using pulverized coal (PC), natural gas-fired combined cycle plants (NGCC), and integrated gasification combined cycle (IGCC) plants using coal or other solid fuels. The model can be employed to identify the most cost-effective carbon capture and storage options for a particular application. It also can be used to quantify the benefits of technology R&D, and to identify advanced technology options having the highest potential payoffs.

Accomplishments

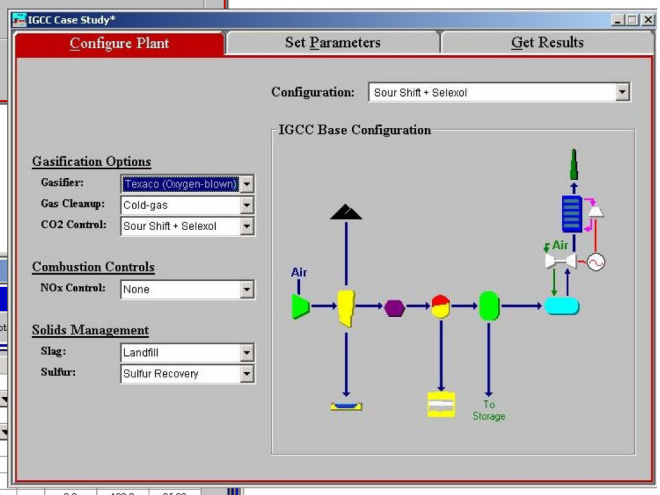
The result of this effort is a computer model called IECM-CS (Integrated Environmental Control Model—Carbon Sequestration Version). This project extends earlier work on emission control options for criteria air pollutants and air toxics. The IECM-CS now includes a set of "baseline" technologies representing currently available CO_2 capture and storage (CCS) systems that could be employed at new or existing fossil-fuel power plants, including PC, NGCC and IGCC units. The cost and performance of CO_2 capture systems are evaluated in the context of multi-pollutant control systems for major air pollutants such as SO_2, NO_x, particulates and Hg. The CCS options include pipeline transport to alternative geologic or other CO_2 storage sites, including EOR and ECBM applications.

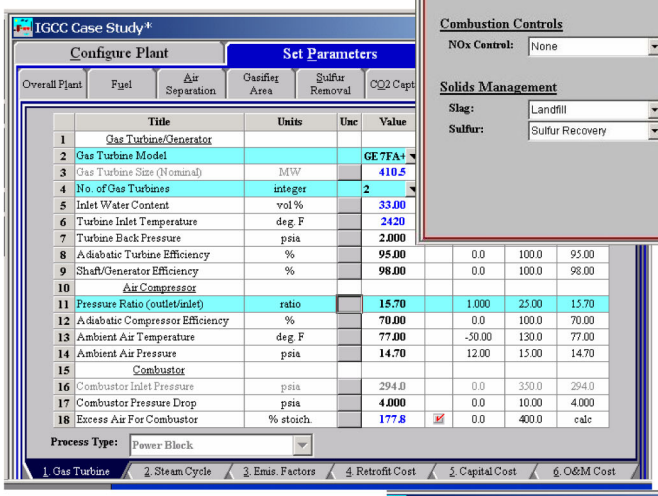
The modeling framework is being further extended to include a set of advanced technology options for both combustion-based and gasification-based systems, including oxyfuel combustion and advanced IGCC plant designs. More detailed models of CO_2 transport and storage options also are under development. The IECM has been used for preliminary evaluations of the cost of CCS using current technology for both new and retrofit applications. It also has been used to assess the uncertainty and variability surrounding cost and performance estimates for CO_2 capture and storage, and the magnitude of potential cost reductions from new or improved capture technology.

Examples of IECM-CS Graphical User Interface Screens

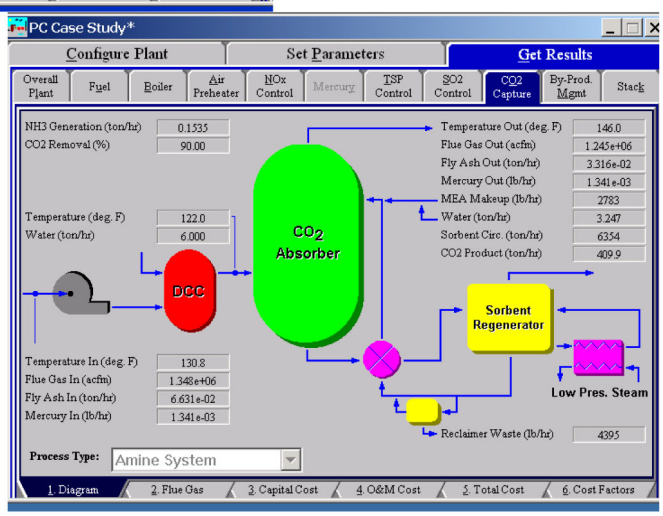


"Configure Plant" screens for a PC plant and an IGCC plant with CO2 capture & storage





Parameter input screen for the gas turbine area of the IGCC plant, and graphical results screen for the CO2 capture system of the PC plant



CUSTOMER SERVICE

1-800-553-7681

WEBSITE

www.netl.doe.gov

PARTNERS

Carnegie Mellon University

COST

Total Cost:
$ 896,400

DOE/Non-DOE Share:
$ 717,200/ $ 179,200

Duration of Contract:
36 months

Benefits

Several important benefits accrue from this project:

- The IECM-CS provides users with a powerful and flexible tool for analyzing the performance and cost of alternative carbon capture technologies for a particular power plant application. In a carbon-constrained world, this will allow companies to avoid the need and high cost of engaging other firms to perform preliminary engineering analyses of CCS options.

- The IECM-CS is publicly available and free of charge to users. Earlier versions of the IECM have been widely distributed and used by a broad range of individuals and organizations with interests in electric power systems and environmental control options.

- The model runs quickly and easily on a modern laptop or desktop computer. Thus, it allows users to perform a wide range of analyses without costly setup time or waiting for results.

- The model is supported by a team of experienced researchers. It is fully documented and updated periodically to reflect ongoing technological developments.

- The “systems” framework embodied in the IECM allows carbon capture options to be evaluated in the context of other power plant emission control requirements. Such interactions can be extremely important, but are often overlooked in studies that focus only on one technology.